THE BIJOU BIOGRAPHIES

LORD KELVIN, G.C.V.O.

JOHN MUNRO

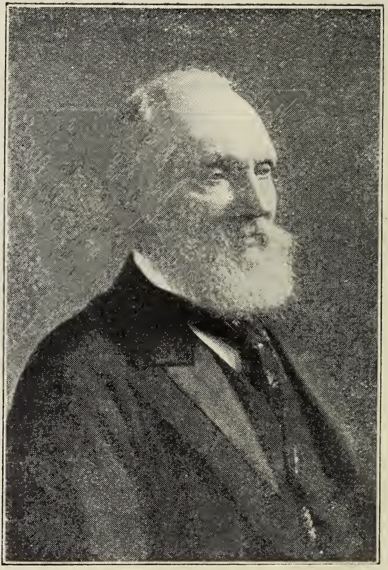

Photo by Messrs. Elliott & Fry.]

LORD KELVIN, G.C.V.O.

Bijou Biographies.—No. IX.

Lord Kelvin, G.C.V.O.

By John Munro,

Author of "A Trip to Venus," &c.

London:
Henry J. Drane, Salisbury House, Salisbury
Square, Fleet Street, E.C.

1902.

PREFACE.

THE story of Lord Kelvin, related in this "Bijou," is "one of the noblest that can be dreamed," as Mascart said, and a veritable romance of science. It coincides with the capture and servitude of that invisible and subtle "demon" lurking in the amber, the lightning flash, and perhaps in everything, whose magical feats have made of the present times an "electrical age." Lord Kelvin has lived to see electricity unite the scattered nations of the earth by a system of metallic nerves—convey their speech, illuminate their darkness, propel their vehicles or machines—and he is, himself, the acknowledged leader and Prometheus of all who direct the mysterious fire of Jupiter.

CAREER OF LORD KELVIN.

Born at Belfast, 1824; removed to Glasgow, 1832; becomes a student of the University of Glasgow, 1834; enters at St. Peter's College, Cambridge, 1841; graduates as Second Wrangler and Smith Prizeman, 1845; works in the laboratory of Regnault, Paris, 1845; becomes Professor of Natural Philosophy in Glasgow University, 1846; invents electrometers, 1846 and onwards; marries Miss Crum, 1852; becomes a director of the Atlantic Telegraph Company, 1856; takes part in the Atlantic Cable Expedition, 1857; patents the mirror galvanometer, 1858; takes part in Atlantic Cable Expeditions, 1858; joins the *Great Eastern* in laying Atlantic cables, 1865, 1866; is knighted, 1866; invents a new astronomical clock, 1869; is engineer for the French Atlantic cable, 1869; becomes a widower, 1870; removes to the new University of Glasgow,

Gilmorehill; invents the siphon recorder, 1870; is president of the British Association at Edinburgh, 1871; goes to Brazil as engineer of South American East Coast cables, 1873; introduces his new wire sounding machine, 1873; revives the Sumner method in navigation, 1873; marries Miss Blandy, 1874; is president of the Society of Telegraph Engineers (now the Institution of Electrical Engineers), 1874; is engineer for West India cables, 1875; introduces his machine for calculating the tides, 1876; is a juror at the Centennial Exhibition, Philadelphia, 1876; is engineer of the Mackay-Bennet (Anglo-American) cable, 1879; delivers the Baltimore Lectures to Professors in the United States and attends the British Association Meeting at Montreal, Canada, 1884; is president of the Royal Society, 1891-6; is president of the International Commission for utilising Niagara, 1891; is created Baron Kelvin, 1892; celebrates his jubilee as professor, 1896; attends the British Association Meeting, Toronto, 1897; retires from his professorship, 1899.

CONTENTS.

Lord Kelvin, G.C.V.O.

CHAPTER I.

A BENT FOR SCIENCE.

In the ranks of science at the present time three captains are supreme in their own lines—Berthellot in France, Virchow in Germany, and Lord Kelvin in the United Kingdom. Yet, although for many years Sir William Thomson had been regarded by his colleagues as the greatest physicist of his generation, when he was elected to the Chair of the Royal Society of London, and subsequently raised to the peerage on his scientific merits, he was something of a "dark horse" to the English public. A man of science may

enjoy a great reputation in his peculiar sphere and still be unknown to the masses. As a rule men do not understand the mystery of his work or appreciate its value, and women prefer accomplishments that appeal more to the heart. Philosophers, alas! do not win the affection of the people so easily as poets, artists, musicians, and actors. They may be respected, even admired; but they are seldom loved, unless by personal friends. In the windows of London photographers we shall find a perfect galaxy of popular favourites, "beauties" of Society displaying their charms, and vanishing goodness knows whither; serpentine skirt-dancers, the last new novelist, the boxing kangaroo, would-be laureates, the singer of an idiotic song, fashionable painters, third-rate actors and actresses, heroes of the day, the hour, the moment—all these and more; but rarely, if ever, a man of

science amongst them, except perhaps a Darwin, a Huxley, or a Tyndall. We may hope to see a muscular athlete like Sandow, but we might look in vain for an intellectual giant such as Lord Kelvin.

The fact is somewhat humiliating in this age of science, and it is worth while to discover the why and wherefore. In the first place, Lord Kelvin has not propounded any revolutionary doctrine such as the origin of species by natural selection, which comes home to everyone and affects his manner of thinking for good or ill. Darwin certainly achieved a great notoriety by showing that mankind were probably descended from monkeys. Lord Kelvin has not shaken any creeds, and his researches are mainly of that abstruse kind which is "caviare to the general." In the next place, he has been too busy in

extending our dominion over matter by original experiments, mathematical reasoning, and useful inventions, to cultivate the literary graces like a Tyndall or a Huxley, and win the plaudits of the multitude by his trenchant criticism or his charming exposition. Moreover, his residence in Glasgow has withdrawn him from the vortex of metropolitan publicity. Had he lived in London, he might have been induced to fritter away his splendid powers on matters of the moment, whereas in Glasgow he was free to employ them in those high investigations for which they were adapted.

The Scotch, be it said, had long regarded him as an intellectual glory, and his photograph was quite a staple in the shops of Sauchiehall and Princes Streets. Many think Lord Kelvin a native of Scotland, but he was born in Belfast on June 26th, 1824. He is,

however, a scion of the Scoto-Irish race of Ulster, which has been so prolific in genius. His father, Dr. James Thomson, was a remarkable man. The son of a small farmer, he taught a school at Ballinahinch in County Down, learning much by himself, and also from the winter sessions at the University of Glasgow. In or about 1812 he became a teacher of mathematics in the Royal Academical Institute, Belfast, and in 1832, thanks to his wide reputation, was appointed professor of mathematics in his *Alma Mater*.

The ancient College of Glasgow, alike venerable by its aspect and its fame, stood on the west side of the High Street at "Bell o' the Brae," a spot memorable for an exploit of Sir William Wallace. The child who was destined to play a heroic part in the field of science lived in the professors' court,

and ran about the College Green where Scott had placed the encounter between Frank and Rashleigh Osbaldistone.

It was perhaps favourable to his originality and the choice of his career that his father undertook his primary education. In 1834, at the age of ten or a little more, the boy matriculated as a student of the college. He attended the logic and "humanity," as well as the scientific and mathematical classes for six years. Apparently he found the benefit of all, and has owned his gratitude to his instructors, notably Prof. Nichol, author of "Nichol's Cyclopedia," a fine lecturer on astronomy. At the class of mathematics or natural philosophy he astonished the older students by his preternatural quickness in solving the problems. His talent for geometry or algebra was undeniable, and in 1841 his father sent him to St. Peter's College, Cambridge.

While yet a boy, he was interested in the figure of the earth, and wrote an essay on it for a university prize. When he was fourteen or fifteen, he read Fourier's great mathematical treatise during the intervals of travelling on a trip of two weeks in Germany, and soon afterwards he wrote some papers in defence of it. One, on "Fourier's Expansions of Functions in Trigonometrical Series," was published in the *Cambridge Mathematical Journal* for 1841, and another, on "The Uniform Motion of Heat in Homogeneous Solid Bodies and its connection with the Mathematical Theory of Electricity," in 1843.

Comrades were struck by his noble enthusiasm for study. Hopkins, his tutor, and other masters regarded him as a coming luminary in science. In 1845 he graduated as the Second

Wrangler, but the Senior perhaps owed his triumph to ready writing, for one of the examiners, or some such authority, was heard to declare that he was "unworthy to cut Thomson's pencils for him." However, the defeated wrangler showed his mettle by winning the harder contest for the Smith prize.

Thomson at Cambridge was not the pale student, worn and weary by the midnight hours, and the long tax on his brain. He was active on many lines, and kept his equilibrium. Music, the most sentimental of the arts, often has charms for mathematicians and inventors, perhaps because it corrects the tendency to abstract thought by stirring up the soul and refreshing them. He was given to it, and became a president of the Musical Society. He also "went in" for manly sports, gained the Colquhoun Sculls, and

rowed in the Peterhouse boat, which held the second place on the river Cam.*

Enrolled a Fellow of St. Peter's, and recognising the importance of experimental training, which he could not find in England, he went to Paris, where Fourier, Ampère, Arago, and others had shown how to combine mathematics with experiment, and entered the laboratory of the celebrated Regnault, who was engaged in his classical determination of certain physical constants.

In 1846, when only twenty-two, he was called to the Chair of Natural Philosophy in his old college at Glasgow, a rise in life as honourable to the wisdom and foresight of the Senate as to his own promising genius. In spite

* I am told, but cannot vouch for it, that he competed for the sculls in a craft, light for those days, of his own design, and won, to the surprise of people, as he had not rowed before.

of tempting offers he never quitted this congenial post, and has rendered it illustrious.

At the outset he began to make researches in electricity, and founded a laboratory, with a corps of students to assist in the work. An old wine-cellar, and later on the disused Blackstone examination room served the purpose. This was the first of many physical laboratories for the training of students in colleges throughout the world, and a great stride in scientific education. One of its advantages was that investigators, partly for lack of apparatus, but also on principle, were left a good deal to their own resources. Many able men have been trained and many important discoveries or inventions have emanated from the murk and dismal old haunt, as well as its bright and airy successor in the new college of Gilmorehill.

In 1852 he espoused Miss Margaret, a daughter of Mr. Walter Crum, F.R.S., of The Rouken, Thornliebank, a famous calico printer, who was distinguished for his investigations on the nature of cotton fibre. She was an accomplished gentlewoman in every sense of the word, and very kind, they say, to the poor.

CHAPTER II.

LINKING THE TWO WORLDS.

A MAN of his pregnant mind and exuberant energy could not subside into a teaching machine. At the very least he would discover and invent. Professor Thomson did much more; he also became a practical engineer, an expert in patent right, a reformer in education, a vital power in the world. Genius makes its own opportunity. When, in 1856, the late Mr. Cyrus Field had begun to realise his gigantic dream of uniting Europe and America by means of a telegraph line across the Atlantic Ocean, a difficulty uprose which threatened to defeat all his plans. The electric signals passing through a long submarine cable were found to drag, and it was a question whether

or not they would travel fast enough between Europe and America to pay. Mr. Faraday explained the mystery by showing that the electricity in the wire was self-impeded by the attraction of an opposite electricity which it excited in the surrounding water. It remained, however, for Professor Thomson to enunciate the law of this retardation and so enable engineers to design a cable which would give a satisfactory speed to the messages. Dr. O. Wildman Whitehouse, electrician to the Atlantic Telegraph Company, contested the accuracy of "Thomson's Law," citing a number of experiments against it, but the young professor quickly disposed of the argument, by showing that these results were actually in favour of it, and the directors of the Atlantic Telegraph Company, recognising his ability, engaged his services. They did well. It is no exaggeration to say that

he contributed more than any other scientific man to the ultimate success of that enterprise which was repeatedly baffled and postponed. He descended in their midst like the very Genius of Electricity and helped them out of all their troubles. In addition to the law which governed the construction of the wire, he gave a theory of the mechanical forces involved in laying it, and devised various means of testing it during the manufacture and submersion.

Moreover, he invented a new instrument for receiving the messages which were to be sent through it. The lagging of the electric currents, before mentioned, has the effect of making them run together into one bottom current with surface ripples which correspond to the separate signals of the message; and the ordinary telegraph apparatus used on overhead lines were not suited for this varying current.

Thomson's "mirror instrument" is, however, beautifully adapted to interpret all its delicate fluctuations. A tiny magnet is fixed on the back of a mirror the size of a threepenny-bit, and suspended by a silk fibre in the centre of a coil of insulated wire, and a beam of lamplight is reflected from the glass upon a white screen. When the current from the cable passes through the coil the mirror-magnet swings to the right or left according as the current rises or falls, and the "spot" of light on the screen betrays its hidden movements to the eye of the telegraphist, who in this way reads the signals of the message. So sensitive is the arrangement that Mr. Latimer Clark, I believe, signalled to America and back through two Atlantic cables with the current from a toy battery made in a silver thimble with a drop of acidulated water and a grain of zinc. The feat

can be done with a voltaic cell made in a percussion cap.

The Government of the United Kingdom had promised Mr. Field a subsidy of £1400 a year, and a loan of ships to submerge the cable between Ireland and Newfoundland. From the Congress of the United States he solicited an equivalent, but a large number of Senators, considering that both ends of the line would rest in British territory, and suspecting the old enemy of their nation of "literally crawling under the sea to get some advantage," opposed the grant. The bill only passed by a single vote. It encountered a like hostility from the Representatives, but was ultimately signed by President Pierce.

The *Agamemnon* (a British) and the *Niagara* (an American) man-of-war took on board the sections made by Messrs. Glass, Elliot & Co. at Greenwich,

and by Messrs. R. S. Newall & Co. at Liverpool. Mr. Field, with Sir (then Mr.) Charles Bright as engineer-in-chief, Professor Morse and Mr. De Sauty as electricians, were attached to the *Niagara*, and Professor Thomson, as well as Dr. Whitehouse, to the *Agamemnon*. The vessels and their consorts met in the Bay of Valentia, in the south-west of Ireland, where, on August 5th, 1857, the shore end was landed from the *Niagara*. It was a memorable scene. The ships at anchor were dressed in bunting, the Lord-Lieutenant with a party stood by the waterside to receive the cable from the American sailors, and the onlookers, in gay attire, joined eagerly in helping to haul it up the beach. When this was done, the Reverend Mr. Day of Kenmore offered a prayer, beseeching the Almighty to prosper the enterprise. Next morning the *Niagara* put to sea,

but ere she had covered five miles the line broke in the gear, delaying her until the morrow.

At first the *Niagara* went slowly ahead in order to avoid a mishap, but as the cable ran freely out of the tank she quickened her pace. Night fell and hardly a soul slept. The utmost vigilance reigned throughout the vessel. Apart from the noise of the paying-out gear and throbbing of the screw, there was an awful stillness on board. Men paced the deck softly, and spoke in a whisper, as if they were afraid the tones of their voices might snap the slender wire.

A submarine hill, and its dangerous peaks or ledges, on which the cable might hang and break, was passed in safety, and the *Niagara* had reached the "telegraph plateau," nearly two miles deep, when the signals from Ireland every few minutes, telling that the

conductor was intact, suddenly came to a stop. Professor Morse and Mr. De Sauty having failed to renew them, the engineers were preparing to cut the cable when, suddenly, they began again, and every face grew bright. Said a weather-beaten old sailor—"I have watched nearly every mile of it as it came over the side, and I would have given fifty dollars, poor man as I am, to have saved it, although I don't expect to make anything by it when it is laid down."

Their joy did not last. The line was running out much faster than the ship was going ahead, and the engineer applied the brakes to check the waste of cable, but owing to a neglect of orders, while the stern of the ship rose on the swell, the cable parted under the heavy strain and the end was lost in the sea. The bad news flashed from one ship to another,

filling all with regret and dismay. No attempt was made to grapple for the line at such a depth, and the "wire squadron," as the blue-jackets called it, returned to England.

The following year, on June 10th, after a trial trip in the Bay of Biscay, the *Niagara* and *Agamemnon* sailed from Plymouth with a full supply of cable, better gear than before, and a riper experience of the operations. Professor Thomson, with his new reflecting galvanometer, was on board the *Agamemnon*. At the solicitation of his fellow-directors he consented to superintend the testing arrangements, and act as electrician in the room of Dr. Whitehouse. According to Mr. Charles Bright, F.R.S.E., a son of the engineer-in-chief, he assumed this arduous position without any kind of recompense, although it involved the temporary abandonment of his

academical work and his philosophical researches.* The vessels were to meet in the middle of the Atlantic where the halves of cable in each of them would be spliced together, and while the *Agamemnon* laid hers eastward to Ireland the *Niagara* was to pay out westward to Newfoundland.

The "fair skies and bright prospects" of the start gave place on Sunday, the 12th, to a terrific storm. The *Agamemnon*, with a coil of cable, weighing 250 tons, forward on the upper deck, suffered the more. The massive beams under the coil on her upper deck (as reported by Mr. Nicholas Woods of the *Times*) "cracked

---

* See "The Life Story of Sir Charles Filston Bright." "As for the professor," said Sir Charles, "he was a thorough comrade, good all round, and would have taken his turn 'at the wheel' (or the brake) if others had broken down. He was also a good partner at whist when work wasn't on, though sometimes, momentarily immersed in cogibundity of cogitation, by scientific abstraction, he would look up from his cards and ask, 'Wha played what?'"

and snapped with a noise resembling that of small artillery, almost drowning the hideous roar of the wind as it moaned and howled through the rigging; jerking and straining the little storm sails as though it meant to tear them from the yards."

Next day the barometer was lower, and, as a matter of course, the wind and sea higher; but at noon the sun pierced through a pall of clouds and shone brilliantly for half an hour, while the wind blew as it had not often blown before. Hours and days went by, the storm gathered in strength, and it was little short of a miracle that any vessel ever lived through it. But the *Agamemnon*, frightfully battered though she was, luckily for science weathered the ordeal, thanks largely to the indefatigable efforts of her crew and the skill of her captain.

On Saturday, the 26th, the middle

splice was made, and the bight sunk in the ocean. The two ships got under weigh, but had not sailed three miles when the cable broke in the paying-out machinery of the *Niagara*. A new splice was followed by another start in the afternoon, but after about fifty miles were laid by each vessel, the current, which kept up a communication between them, suddenly failed owing to the wire severing in the water. A third splice was made and lowered, and the vessels parted company. For a day or two all went merrily, over two hundred miles of the cable running smoothly out of each hold, and the anxious chiefs were beginning to indulge in sanguine hopes of success, when the line snapped a little astern of the *Agamemnon*.

The squadron put back to Queenstown, where a consultation was held, and Professor Thomson as well as

Mr. Field advocated another trial. On the 17th of July the ships left the Cove of Cork, but wiseacres now shook their heads at the project as a "mad freak;" there was no enthusiasm on shore, and the crews on board felt as if they were going on a wild goose chase.

This time, in making for the rendezvous, the *Agamemnon* was delayed by calm weather. On July 29th, however, at mid-day, the splice was dropped into the sea. The vessels parted, and the cable glided freely out of them. An alarm was caused by the stoppage of the "continuity" signals from one to the other, but after a time they reappeared all right. The *Niagara* deviated from the arc of a "great circle" along which the cable was being laid, and as the error was traced to its iron sheath affecting her compass, the *Gorgon*, one of her consorts, went to the front and led the way. They passed a

number of icebergs, but none injured the wire, and on August 4th anchored in Trinity Bay, Newfoundland. At six o'clock next morning the shore end was landed into the cable house. Captain Hudson then mustered the crew for prayers, and at one o'clock the *Gorgon* fired a salute of twenty-one guns.

The *Agamemnon* had more adventures, for about six o'clock on the first evening a huge whale approached her on the starboard bow, and as he sported in the waves, rolling and lashing them into foam, the spectators began to fear that he might break the cable. Their excitement grew intense while the monster heaved in the wake nearer and nearer to the line until his body grazed it where it sank into the water, but happily no damage was done. A faulty piece of the cable had to be removed in paying-out, and cessation of the continuity signals raised other alarms on

board. Two American ships got into the course, and had to be warned oft by firing guns. The signals from the *Niagara* became very weak, but on Professor Thomson asking the electricians there to increase the power of the current they revived. At length, on 5th August, the *Agamemnon* with her consort the *Valorous* arrived in Valentia bay, and by three o'clock in the afternoon the shore end was landed into the cable house at Knightstown. A royal salute announced the completion of the work.

The news, in spite of some incredulity at first, was received with general delight. Queen Victoria sent a telegram of congratulation to President Buchanan, expressing a hope that the cable would be "an additional link between the nations whose friendship is founded on their common interest and mutual esteem." The President, in

responding, described the feat as a "triumph more glorious, because far more useful to mankind, than was ever won by conqueror on the field of battle. May the Atlantic cable, under the blessing of Heaven, prove to be a bond of perpetual peace and friendship between the kindred nations, and an instrument destined by Divine Providence to diffuse religion, civilisation, liberty, and law throughout the world."

These messages were the signal for a fresh outburst of pent enthusiasm. Next day a grand salute of a hundred guns resounded over New York, the streets were decorated with flags, the bells of the steeples rang, and the city was illuminated at night. The Atlantic cable was a theme for innumerable sermons and a prodigious quantity of doggerel.

The climax of rejoicing was reached in September. A public service was

held in Trinity Church, and Mr. Field, as mainspring of the exploit, received an ovation at the Crystal Palace, New York. The Mayor of the city presented to him a golden casket as a souvenir of the "grandest enterprise of our day and generation." The band played "God Save the Queen," and the entire audience rose to their feet. In the evening there was a fine torchlight procession of the firemen. Alack!

> "The best laid schemes o' mice an' men,
> Gang aft a-gley."

The cable in the meantime had breathed its last!

Its health—in other words, the insulation of the conductor from the sea-water—had been failing for several days, and the only signals which could be "read" through it were those given by the new mirror galvanometer ot Kelvin. So great was the leakage of electricity from the line that even this

delicate instrument was useless without employing a very strong current, and when it suddenly died Newfoundland was vainly trying to "speak" Valentia with a battery of 312 cells. The cause of the breakdown is uncertain. Perhaps it was overstrained in the laying, perhaps it was chafed through on a submarine rock, but it seems more likely that a flaw in the manufacture, a mere filament or bubble of air in the gutta-percha, crushed by the pressure of the sea or charred by the powerful current, was to blame for the rupture in the core.

The reaction at this anti-climax was tremendous. Writers hinted that the cable was a clever hoax, or declared it a speculation of the Stock Exchange. Sensible folk doubted whether any messages had ever passed through it. In addition to the Royal and Presidential despatches, however, items of ordinary

news had been sent; for instance, a collision between the *Europa* and *Arabia*, off Cape Race, and an order from London countermanding the departure of a regiment in Canada for India since the Mutiny had come to an end.

Mr. Field and his colleagues, although saddened, were far from daunted, and since they had come so near a permanent success, were eager to resume the work; but the public had lost their confidence in the scheme, and all his efforts to reanimate the company were futile. It was not until 1864 that, assisted by Lord (then Mr.) Brassey and Mr. (afterwards Sir) John Pender, he succeeded in raising the necessary capital. The Glass Elliot and other companies were combined into the well-known Telegraph Construction and Maintenance Company to make and lay a new cable.

A committee of experts had in-

vestigated the whole subject of cables, and much experience was gained in submerging lines through the Mediterranean and Red Sea. The *Great Eastern*—which Brunel the famous engineer had shown to Cyrus Field at Blackwall ten years before, with the remark, "There's the ship to lay the Atlantic cable"—was purchased, then fitted with tanks for the wire, paying-out gear and testing apparatus. Captain (latterly Sir) James Anderson, a thorough seaman, from the Cunard steamer *China*, was put in command, with Captain Moriarty, R.N., a skilful navigator, from the *Agamemnon*, to mark the course. Sir (then Mr.) Samuel Canning was the engineer, and Mr. De Sauty the electrician for the contractors, while Professor Thomson and Mr. Cromwell Fleetwood Varley were electricians for the Atlantic Telegraph Company.

The *Great Eastern*, with seven or

eight thousand tons of coal, besides the cable, stores, and live stock—which turned her decks into a farmyard—steamed to Foilhommerum Bay, Valentia, where the shore end was laid by the *Caroline;* and on July 23rd, 1865, amidst the firing of cannon and the cheering of her consorts, began her voyage. The weather was fine, and all went right until next morning, when the boom of a gun told that a fault had appeared in the cable. It was found that a splinter of iron wire had penetrated the core. Many faults of the kind were discovered, and, as they always occurred in the same watch, foul play was feared. In repairing one of them on July 31st, after a thousand miles and more had been laid, the cable snapped near the stern of the ship. "All is over," said Mr. Canning, quietly; and their spirited attempts to grapple the sunken line in water two

miles deep were of no avail. The *Great Eastern* returned home, and the indomitable Mr. Field issued another prospectus, to form the Anglo-American Telegraph Company and complete the abandoned line as well as lay another. On 13th July, 1866, after the shore end was landed at Valentia by the *William Cory*, and a service of prayer, the *Great Eastern* again started, with Professor Thomson on board. The "big ship" had three consorts—the *Terrible* and *Medway* to warn other vessels off the track, and the *Albany* to drop or pick up her buoys. Despite the fickleness of the weather and a "foul flake" or clogging of the line as it ran from the tank, there was no mishap. The old "coffee-mill," as the sailors dubbed the paying-out gear, kept grinding away. "I believe we shall do it this time, Jack," said one tar to his mate. On 27th July they arrived off

Trinity Bay during a thick fog, and the next morning anchored at Heart's Content. Flags were flying on the little church and the telegraph station. The *Great Eastern* was dressed, three cheers were given and a salute fired. At nine o'clock a message from England through the cable cited these words from a leading article in the *Times*—"It is a great work, a glory to our age and nation, and the men who have done it deserve to be honoured among the benefactors of their race." Another message ran—"Treaty of peace signed between Prussia and Austria." The *Medway* landed the shore end the same day, and Captain Anderson, with the officers of the squadron, went to the church to return thanks for their success. Congratulations were poured in, and friendly telegrams were again exchanged between Her Majesty Queen Victoria and the President of the United

States. The dream of Cyrus Field was now realised, and the two worlds finally conjoined for good or evil.

On August 9th the *Great Eastern* set forth to grapple for the lost cable of 1865. Captain Moriarty found its position in the middle of the ocean within a quarter of a mile, and, after many failures, it was hooked in some two miles of water, lifted on board and spliced to the cable in the hold; then, paying out as she went, the *Great Eastern* made Heart's Content on September 7th, and so doubled the cord of intelligence and sympathy between the two hemispheres.

The Atlantic cable brought the name of Professor Thomson into public notice, and when the Old World was finally coupled to the New by the *Great Eastern* in 1866, he, on returning home, was knighted by the Lord-Lieutenant of Ireland.

CHAPTER III.

HIS INVENTIONS.

The cable of life is ever thrilling with messages of joy and sorrow. In 1870 Lady Thomson, after a long illness, died, and the shock, partly for distraction, plunged her husband deeper into original work. The rise of a new industry is one of those tides in the affairs of men which lead to fortune, and Sir William took advantage of it. With the "mirror instrument" the message leaves no trace, but has to be written down by the receiving clerk. Sir William therefore set himself to devise an apparatus which would write the message as it comes, and eventually produced his matchless "siphon recorder," which, along with the "mirror," is now employed on most of the submarine cables

throughout the globe. In this apparatus a light coil of insulated wire is suspended between the poles of a strong magnet, and connected to a fine glass siphon discharging ink on a moving strip of paper. When the electric current from the cable is passed through the coil it swings to one side or the other, like the needle in the mirror instrument, and, swerving with it, the point of the siphon pen draws a wavering line on the paper, which is a permanent record of the message.

In this age of invention most of us know the peculiar poetry and fascination of mechanism. A locomotive rushing along a railway at high speed, the sudden drop of the signal whilst we are looking at it, the smooth and stately play of some great beam engine, strike us with feelings of awe and admiration. Such mysterious and orderly movements convey an impression of personality in the

machine. They appear to evince the working of a hidden life, impetuous, exact, or majestic, according to their nature, but always remote and alien, as that of beings captured from another sphere. Reason turns our admiration from the creature to its creator, and we honour the human genius which has endowed us with these captives from the unknown.

The sense of a soul in mechanism is particularly evident in the case of a telegraph instrument receiving a message from a distant country, whether it be the chattering "sounder," the clicking "printer," the "mirror" galvanometer with its wandering spot of light on the screen, or, above all, the glib and silent writing of the "recorder." Thanks to the invisible current, they seem instinct not only with life but with intelligence. I felt this while standing beside a recorder about six

o'clock one morning in the office of the Eastern Telegraph Company at Marseilles. It was connected to the cable, and could receive its message in the absence of the attendant. The tired clerk, after his long night-shift, was fast asleep in his chair. All at once the instrument began to "speak." The exquisite pen, like a mere bristle of glass, was drawing its frail and wavering line on the running scroll of paper. Quickly the message came, letter by letter, word by word: "The Prince of Wales [now King], Indore, to the Princess of Wales, Windsor. Many happy returns of this dear day. Sorry we are so far apart." It was the anniversary of his marriage.

Simple as they appear in a short description, these rare inventions, owing to the subtlety of the problem, were not constructed without infinite pains. To exploit them properly Sir William

entered into a partnership with the late Mr. Cromwell Fleetwood Varley, F.R.S., who first introduced the condenser to sharpen the cable signals, and the late Mr. Fleeming Jenkin, Professor of Engineering in Edinburgh University, in conjunction with whom, in 1876, he brought out an automatic signalling key. The recorder was first adopted by the late Sir John Pender on the Falmouth and Gibraltar cable, and made a public appearance at the novel telegraphic *soirée* held in the summer of 1870 at his residence in Arlington Street.* On this occasion the King, then Prince of Wales, and a fashionable party took supper in a marquee into which telegraph wires from India, America, and other distant countries were brought, and Lady Mayo, wife of the Viceroy, despatched a message

* A fuller account of his inventions is given in "Heroes of the Telegraph."

to her husband in India at about half-past eleven, and received a reply before midnight, informing her that he was quite well at five o'clock next morning.

Sir William and Professor Jenkin acted as the engineers for a number of submarine cables, including the French-Atlantic of 1869 and the Mackay-Bennett Atlantic of 1879, as well as the Brazilian and the River Plate cables of 1873 and onwards, and the West Indian links of 1875.

They accompanied more than one of these expeditions, and on their way to Pernambuco in the summer of 1873 the cable ship touched at Madeira, where, as Jenkin said, Thomson was "up sounding with his special toy" at half-past three in the morning, the toy being his new machine for using a steel pianoforte wire in place of the ordinary lead-line. The wire slips through the water so cleanly that "flying soundings"

can be taken as the vessel is going at full speed, and a pressure gauge at the sinker tells the depth.

The late Mr. James White, of Sauchiehall Street, Glasgow, an amiable and worthy man as well as a skilful mechanician, used to relate an anecdote about the new appliance for sounding with great gusto. Mr. White was philosophical instrument maker to the University, a post once held by James Watt, and most of Sir William Thomson's apparatus were first constructed by him. One day, while the sounding machine was in preparation, Sir William entered his old shop in Buchanan Street along with a guest, no other than the late Dr. Joule of Manchester, celebrated for his determination of the mechanical equivalent of heat. Joule's attention was called to a bundle of the pianoforte wire lying in the shop, and Thomson

explained that he intended it for "sounding purposes." "What note?" innocently inquired Joule, and was promptly answered, "The deep C."

Whilst at Madeira he made the acquaintance of his future wife, Miss Frances Anna, daughter of Mr. Charles R. Blandy, the present Lady Kelvin. When dark it was easy to signal with lamps between the cable ship in Funchal Bay and the house of Mr. Blandy on the hillside, and, after a little practice, they amused themselves in carrying on a conversation by long and short flashes, according to the Morse telegraph code. Next May the *Lalla Rookh* again wafted him to the lovely island, this time for his bride.

At that period he devised a means of enabling a lighthouse to signal its distinctive number by long and short flashes, and also revived the neglected Sumner method of ascertaining a ship's

place at sea, which Captain Moriarty had employed with good effect in laying and repairing the first Atlantic cables.

His most important aid to navigation is, however, the adjustable compass which bears his name. Its origin is another proof that no labour is lost, no fact is useless, and that even the despised "popular" science can be of inestimable value either to the giver or the receiver. Any experience, however old or trivial, may start a good idea in a fertile imagination, especially if it be primed with knowledge and quickened by the act of reading or of writing with attention. In 1874 Sir William began an article in *Good Words* on the mariner's compass, but a little to the wonder of the readers the second part did not appear until five years later. In the meantime he had invented an improved compass of his own, far superior to those in use

On writing the first paper he became alive to the faults of existing compasses, and set himself to produce one steadier at sea than the others, and cured of the error arising from the magnetism of the ship. "When there seemed a possibility of finding a compass which should fulfil the conditions of the problem," says Sir William, in his "Popular Lectures and Addresses," "I felt it impossible to complacently describe compasses which perform their duty ill, or less well than might be, through not fulfilling these conditions." Contrary to the usual practice, he increased the steadiness of the card by lightening it and attaching to it several fine parallel, instead of one or two thick, needles. Moreover, he compensated the magnetism of the ship by the aid of magnets and masses of soft iron placed at or near the binnacle, after a method

published in 1837 by Sir George Biddell Airy, the late Astronomer Royal.

A wise Providence has imbued the soul of the inventor with a parental fondness for the creature of his brain and a sanguine faith in its future. Were it not so he might lose heart in the face of difficulties, whether arising from its own defects, or the indifference, even the opposition, of the world, and so his offspring would probably die of neglect. It often happens that learned experts cannot see the merits of a new invention, and in the pride of their superior wisdom sometimes damp the zeal of the inventor with the cold water of their adverse criticism. Did not Professor Poggendorff, of the *Annalen*, stigmatise the first telephone of poor Phillipp Reis as a chimera? Even the telephone of Bell and the phonograph of Edison were at first

regarded as mere toys. One day, I remember, Sir William Thomson desired me to take his new compass to Sir George Airy at the Royal Observatory, Greenwich Park, and ask him what he thought of it. A crude, experimental instrument, mounted on gimballs in a wooden box, it nevertheless contained the essential features of the improvement, and after I presented it to Sir George, he looked intently at it for some time, apparently in deep thought, then shook his head, and simply said, "It won't do." When I returned to Sir William, and told him of this verdict, he ejaculated, with a trace of contempt, "So much for the Astronomer Royal's opinion!" The event showed that he was right, for the Kelvin compass is the best extant.

Sir William has done more than any other electrician, living or dead, to introduce accurate methods of measuring

electricity. As early as 1845 and onwards he devoted himself to this task, ascending Goatfell in Arran to measure atmospheric electricity, and, in addition to a large number of ingenious tests, familiar to electrical engineers all over the world, he invented two complete series of exquisite apparatus for measuring the electrical forces, both static and dynamic—that is to say, of electricity at rest and electricity in motion. Among the most useful of these are his portable, absolute, and quadrant electrometers, his delicate mirror galvanometer, a higher type of his "mirror instrument," which has become the mainstay of the electrician, and his more recent graded galvanometers, voltmeters, and balances, especially useful in electric light and power installations. Owing to his intimate knowledge of electricity, mechanics,

and the properties of matter in general, as well as his intolerance of any imperfection or mere approximation to what is feasible, his instruments are thoroughly reliable, and the electrician uses them with the entire assurance that they are the finest and most accurate for the purpose in the present state of science. As to generators of the electric current, he has devised more than one form of voltaic battery, including a standard Daniell, for comparisons, and a large tray cell for giving a powerful current, as well as a dynamo which he brought out in conjunction with Mr. Ferranti. A machine for predicting the level of the tides in any part of the world is probably his chief non-electrical invention. It can draw a curve of the tide at any port for the entire year in four hours, and was exhibited at the Loan Exhibition of Scientific Apparatus,

South Kensington, in 1876, where Sir William had the honour of explaining its action to the Queen. He also invented the astronomical clock that stood in the hall of his house at the new college, and a mechanical calculator for solving differential equations.

CHAPTER IV.

HIS DISCOVERIES.

CONCURRENTLY with these and other inventions Thomson has carried out an immense number ot experimental and mathematical researches in every department of natural philosophy. Indeed, his scientific renown culminates over his discoveries rather than his inventions. Of his discoveries, the mathematical outnumber and probably outweigh the experimental results. The strongest point, the true citadel of his genius, is perhaps the faculty of applying mathematics to the solution of physical problems. Like reformers in art and religion he goes to Nature, seeking a pure, simple, and precise expression for the laws of the phenomenon. Turn anywhere in the

annals of modern science and we shall find his name; but in molecular physics, above all, in electricity, it is dominant. In dynamics it is coupled with Tait; in the dynamical theory of gases with Mayer and Helmholtz; in heat with Joule, Clausius, and Rankine; in electricity with Faraday, Maxwell, and Heinrich Hertz. Faraday surmised that electric and magnetic forces acted through an invisible "medium," he knew not what, and Kelvin explained them by stresses in the ether—an "elastic solid" or substance, not unlike a "jelly" or "cobbler's wax" in its power of transmitting vibrations and resisting penetrations. He discovered the electric oscillations or surges produced in the ether by the spark of a Leyden jar, which led Maxwell to show by mathematics that electro-magnetic waves in the ether were the same as light, and Hertz to prove it by

experiment. It is, therefore, to Kelvin's electric waves, developed by Maxwell, Hertz, and others, that we owe the "wireless telegraph." In his Baltimore lectures to professors he revealed some of the inner mysteries of light, its radiation, absorption, and fluorescence, in connection with ether. He is also a promoter of hydrodynamics; and, in short, the fundamental principle of his work is to refer all the properties of matter to ether and motion.

Many of his papers are highly abstruse, and their mathematics can only be read by the mightiest intellects. The titles alone are sufficient to stagger the general reader. The ordinary scientific jargon is bad enough, but Lord Kelvin, like Thomas Carlyle and some other great writers, seems to have devised a peculiar style of his own to express the workings of his mind.

Witness the following title of a paper

read before a meeting of the British Association at Edinburgh in 1892: "The Reduction of Every Problem of Two Freedoms in Conservative Dynamics to the Drawing of Geodetic Lines on a Surface of given Specific Curvature." Here is a still more elaborate specimen of Kelvinese:—"A Simple Hypothesis for Electro-Magnetic Induction of Incomplete Circuits, with Consequent Equations of Electric Motion in Fixed Homogenous and Heterogenous Solid Matter."* The point of the joke lies in the word "simple." Apart from technicality, some of his sentences have quite a Gladstonian length and scrupulosity of qualification. No doubt they evince the extraordinary grasp and fine discrimination of his intellect, but they are often a severe tax on the intelligence

* Paper read at the British Association Meeting, Bath, 1888.

of the reader. For example: "Two or more straight parallel conductors, supposed for simplicity to be infinitely long, have alternating currents maintained in them by an alternate current dynamo, or other electromotive agent applied to their ends at so great a distance from the portion investigated that in it the currents are not sensibly deviated from parallel straight lines. The other sets of ends may, indifferently in respect to our present problem, be either all connected together without resistance, or through resistance, or through electromotive agents. All that we are concerned with at present is, that the conductors we consider form closed circuits, or one closed circuit, and that therefore the total quantities per unit of them at any instant traversing the normal section in opposite directions are equal."

Take another and later specimen:

"Continuity in undulatory theory of condensational-rarefactional waves in gases, liquids, and solids, of distortional waves in solids, of electric waves in all substances capable of transmitting them, and of radiant heat, visible light, ultra-violet light.*

"Consider the following three analogous cases:—I. Mechanical; II. Electrical; III. Electromagnetic.

"I. Imagine an ideally rigid globe of solid platinum of 12 centim. diameter hung inside an ideal rigid, massless, spherical shell of 13 centim. internal diameter, and of any convenient thickness. Let this shell be hung in air or under water by a very long cord, or let it be embedded in a great block of glass, or rock, or other elastic solid electrically conductive or non-conductive, transparent or

* Paper read at the British Association Meeting, Bristol, 1898.

non-transparent for light. . . ." Need we go on? It is evidently one of his papers only understood by himself.

New terms become necessary in the progress of a science, and Sir William, like his late brother, Professor James Thomson of Glasgow University, has a propensity—I had almost said a "craze"—for coining them. It is not always easy to invent a word that shall be apt, brief, and euphonious without ambiguity of meaning. "Radian," for the unit angle, is one of his brother's happiest efforts, and "ward," for the direction of a force, is perhaps one of his unluckiest, as it is already over-tasked in connection with locks, gaols, hospitals and guardians. To Sir William electricians are indebted for the useful word "mho," the reciprocal of the "ohm," or unit of resistance; while "motivity," "diffusivity," "irrotational circulation,"

"infinitesimal satellites," are some of the lingual jetsam which he is in the habit of throwing overboard and leaving to sink or swim. These peculiarities of style render some of his books, such as the classical "Thomson and Tait's Natural Philosophy," pretty stiff literature. His class book, Thomson and Tait's "Elements," was a theme of jest amongst the feebler students whose mental digestion required a spoon diet. It is undoubtedly a concentrated pabulum—a kind of mental pemmican; but the sturdier scholars loved to sharpen their understandings on its hard and wholesome fare.

Even his "Popular Lectures and Addresses" is not quite free from the tendency of his powerful and cultivated mind to "fly over the heads of his audience," but on the whole it keeps within the reach of the beginner, and, in spite of some difficult sentences, it

is an intellectual treat of the highest order. Its educational value in opening the mind of the tyro to the wonders of that molecular mechanism "in which we live, move, and have our being," cannot be over-estimated, and it possesses the indescribable charm of originality, the verve and vigour of a splendid intellect at home in the subject. The miscellaneous contents of the book afford an illustration of the rich variety and vast extent of his attainments as well as the peculiar bent of his speculation. His imagination delights in ranging from the infinitesimally small to the inconceivably great, from the vibration of a molecule to the origin of the solar system. Here we find him discussing the cause of the earth's magnetism, a problem which has occupied his thoughts for many years, but apparently without bringing him any nearer to a solution. There

he is estimating the size of an atom, and with more success. He would fain persuade us that it is not so very minute after all. "Imagine," he says, "a globe of water or glass as large as a football to be magnified up to the size of the earth, each constituent molecule being magnified in the same proportion. The magnified structure would be more cross-grained than a heap of small shot, but probably less cross-grained than a heap of footballs."

Not content with measuring atoms, he would tell us how they are formed. For centuries after Democritus suspected their existence they were supposed to be hard, solid pellets, until Hobbes raised the question whether they might not be simply modes of motion in a fluid occupying space, and Mallebranche ("Recherche de la Verité," 1712) suggested that they were "petits tourbillons," or vortices.

When in 1867 Lord Kelvin saw the experiments of his friend, Professor P. G. Tait, on "Smoke Rings," such as issue at times from the funnel of a locomotive or the lips of a smoker, in illustration of Helmholtz's investigations of vortex motion in a liquid, he discerned in the flying whirls of vapour ejected from the experimental mouthpiece a type of motion which, occurring in a frictionless, incompressible, and primordial fluid, might account for all the known properties of matter. Once created, such atoms would continue to exist through all the combinations and dissociations of chemistry, until they were destroyed by their Maker. This, I believe, is the darling hypothesis of Lord Kelvin; and, according to Professor Ewing of Cambridge, he was once heard to avow that he regarded the time he spent on other subjects as in a manner wasted.

Some of his deductions from the dynamical theory of heat are of an important character. In showing that the earth was a red-hot ball perhaps twenty or a hundred million years ago, he imposed a serious check on those geologists and Darwinians who demanded unlimited time for the development of the earth's crust, and the different species of animals. On the meanest proof in the laboratory, on what seems a worthless trifle to the novice, he dares to found the grandest generalisation. One of his experiments to demonstrate that our globe has a solid, not, as was believed, a fluid interior, is worthy of Columbus. He takes two eggs, one hard boiled the other raw, and, after suspending them from cords, sets them spinning like the earth. In a short time the raw egg comes to rest, but the boiled one spins on as merrily as

before; and hence he concludes that if the earth had a liquid core it would soon be stopped by its internal friction.

"The essence of science, as is well illustrated by astronomy and cosmical physics," he declared in his address to the British Association at Edinburgh in 1871, "consists in inferring antecedent conditions, and anticipating future evolutions, from phenomena which have actually come under observation. In biology the difficulties of successfully acting up to this ideal are prodigious. The earnest naturalists of the present day are, however, not appalled or paralysed by them, and are struggling boldly and laboriously to pass out of the mere 'Natural History stage' of their study, and bring zoology within the range of Natural Philosophy. A very ancient speculation, still clung to by many naturalists (so much so that I have a choice of

modern terms to quote in expressing it), supposes that, under meteorological conditions very different from the present, dead matter may have run together or crystallised or fermented into 'germs of life,' or 'organic cells,' or 'protoplasm.' But science brings a vast mass of inductive evidence against this hypothesis of spontaneous generation, as you have heard from my predecessor in the Presidential chair. Careful enough scrutiny has, in every case up to the present day, discovered life as antecedent to life. Dead matter cannot become living without coming under the influence of matter previously alive. This seems to me as sure a teaching of science as the law of gravitation. I utterly repudiate, as opposed to all philosophical uniformitarianism, the assumption of 'different meteorological conditions'—that is to say, somewhat different vicissitudes of

temperature, pressure, moisture, gaseous atmosphere—to produce or to permit that to take place by force or motion of dead matter alone, which is a direct contravention of what seems to us biological law. I am prepared for the answer, ‘ Our code of biological law is an expression of our ignorance as well as of our knowledge.’ And I say yes: search for spontaneous generation out of inorganic material; let anyone not satisfied with the purely negative testimony of which we have now so much against it, throw himself into the inquiry. Such investigations as those of Pasteur, Pouchet, and Bastian are among the most interesting and momentous in the whole range of Natural History, and their results, whether positive or negative, must richly reward the most careful and laborious experimenting. I confess to being deeply impressed by the evidence

put before us by Professor Huxley, and I am ready to adopt as an article of scientific faith, true through all space and through all time, that life proceeds from life, and from nothing but life.

"How then did life originate on the Earth? Tracing the physical history of the Earth backwards, on strict dynamical principles, we are brought to a red-hot melted globe on which no life could exist. Hence when the Earth was first fit for life, there was no living thing on it. There were rocks, solid and disintegrated, water, air all round, warmed and illuminated by a brilliant sun, ready to become a garden. Did grass and trees and flowers spring into existence, in all the fulness of ripe beauty, by a fiat of Creative Power? or did vegetation, growing up from seed sown, spread and multiply over the whole Earth? Science is bound by

the everlasting law of honour to face fearlessly every problem which can fairly be presented to it. If a probable solution, consistent with the ordinary course of Nature, can be found, we must not invoke an abnormal act of Creative Power. When a lava stream flows down the sides of Vesuvius or Etna it quickly cools and becomes solid; and after a few weeks or years it teems with vegetable and animal life; which, for it, originated by the transport of seed and ova, and by the migration of individual living creatures. When a volcanic island springs up from the sea, and after a few years is found clothed with vegetation, we do not hesitate to assume that seed has been wafted to it through the air, or floated to it on rafts. Is it not possible, and if possible, is it not probable, that the beginning of vegetable life on the Earth is to be similarly explained? Every

year thousands, probably millions, or fragments of solid matter fall upon the Earth—whence came these fragments? What is the previous history of any one of them? Was it created in the beginning of time an amorphous mass? This idea is so unacceptable that, tacitly or explicitly, all men discard it. It is often assumed that all, and it is certain that some, meteoric stones are fragments which had been broken off from greater masses and launched free into space. It is as sure that collisions must occur between great masses moving through space as it is that ships, steered without intelligence directed to prevent collision, could not cross and recross the Atlantic for thousands of years with immunity from collisions. When two great masses come into collision in space it is certain that a large part of each is melted; but it seems also quite certain that in

many cases a large quantity of *debris* must be shot forth in all directions, much of which may have experienced no greater violence than individual pieces of rock experience in a landslip or in blasting by gunpowder. Should the time when this Earth comes into collision with another body, comparable in dimensions to itself, be when it is still clothed as at present with vegetation, many great and small fragments carrying seed and living plants and animals would undoubtedly be scattered through space. Hence and because we all confidently believe that there are at present, and have been from time immemorial, many worlds of life besides our own, we must regard it as probable in the highest degree that there are countless seed-bearing meteoric stones moving about through space. If at the present instant no life existed upon this Earth, one such

stone falling upon it might, by what we blindly call *natural* causes, lead to its becoming covered with vegetation. I am fully conscious of the many scientific objections which may be urged against this hypothesis, but I believe them to be all answerable. I have already taxed your patience too severely to allow me to think of discussing any of them on the present occasion. The hypothesis that [some] life [has actually] originated on this Earth through moss-grown fragments from the ruins of another world may seem wild and visionary; all I maintain is that it is not unscientific, [and cannot rightly be said to be improbable].

"From the Earth stocked with such vegetation as it could receive meteorically, to the Earth teeming with all the endless variety of plants and animals which now inhabit it, the step is

prodigious; yet according to the doctrine of continuity, most ably laid before the Association by a predecessor in this chair (Mr. Grove*) all creatures now living on the Earth have proceeded by orderly evolution from some such origin. . . .

"But overpoweringly strong proofs of intelligent and benevolent design lie all around us, and if ever perplexities, whether metaphysical or scientific, turn us away from them for a time, they come back upon us with irresistible force, showing to us through Nature the influence of a free will, and teaching us that all living beings depend on one ever-acting Creator and Ruler."†

This bold and startling speculation, which fell like a meteorite on the audience, was met with doubt and

* Afterwards Sir William Grove. Address at Nottingham, 1866.

† Popular Lectures and Addresses, Vol. II., 1894.

derision. Seemingly it astonished even his old and intimate friend Professor Tait, who, as I learn on good authority, was disposed to laugh it over as a kind of scientific joke. Kelvin, I presume, scouted the notion that he was jesting, and ignored, or else disdained, the criticism of the Press. He was never more in earnest. It is obvious that he still maintains his conjecture, since only a few words in brackets were added to the reprint of his original statement. A report that carbon from an organic source, if I am not mistaken, was discovered in a meteorite is perhaps in its favour, but there is little or no convincing proof against or for it. Our ideas of the universal plan are wider now, and it is not so visionary as it looked at first. Nay, it seems rather a crude hypothesis, for, setting aside spontaneous generation as not proven, the seeds of life may be floating like

meteorites through space and ready to sow the crust of a new and virgin planet. Indeed, all the means of creation, whatever is wanted for the production of a living and thinking world, when the foundation of dead matter has come together, may co-exist everywhere.

The sun and its system were, in his opinion, originally formed by the collisions of meteoric stones or defunct planets, as imagined by the illustrious La Place, and he has calculated the conditions of the genesis. In course of time as these bodies cool down they too will die, as poets from Ossian to Lord Byron have prefigured. Indeed, according to his theory of the dissipation of energy, the entire universe would come to a state of rest and death, if it were finite and left to obey existing laws. But as it is impossible to conceive a limit to the extent of

matter in the universe, "science points rather to an endless progress, through an endless space, of action involving the transformation of potential energy into palpable motion, and thence into heat, rather than to a single finite mechanism running down like a clock and stopping for ever. It is also impossible to conceive either the beginning or the continuance of life without an over-ruling Creative Power, and therefore no conclusions of dynamical science regarding the future condition of the earth can be held to give dispiriting views as to the destiny of intelligent beings by which it is at present inhabited."

CHAPTER V.

HIS PUBLIC SERVICE AND REWARDS.

In conjunction with his studies Lord Kelvin has led an active public life. The six months' holiday of the University and the liberality of the Senate have enabled him to exercise his practical ability in numerous ways and in different countries. As a token of his appreciation of this privilege he has founded a Kelvin Scholarship of experimental physics in connection with his class; but a better compensation is the glory of his name, which has attracted students to the University from all parts of the world. Amongst his miscellaneous work I may mention that as an examiner at Cambridge he, as well as Clerk Maxwell, infused a new life into the mathematical teaching

there, and established the science tripos. His telegraph work has already been referred to, and of late years, since the introduction of the telephone, electric light, and electric power, he has been exceedingly busy as a consulting engineer for public companies engaged in these businesses. In 1891, for example, he was appointed president of the International Commission for the purpose of deciding on the best way of utilising the water power of Niagara, and since then has acted in a similar capacity for the Aluminium Works at the Falls of Foyers. Moreover, he is often called as a scientific expert or witness in questions of patent right, as a member of Royal Commissions and scientific committees, a juror at Exhibitions, and so on.

Besides his duties as a councillor of learned societies he also presides

and speaks at the meetings of other corporations. For many years he has taken an active interest in politics, and his views on Home Rule may be gathered from a speech he delivered at a dinner in celebration of the Jubilee of the Telegraph in 1887:—"I must say there is some little political importance in the fact that Dublin can now communicate (by telegraph) its requests, its complaints, and its gratitudes—(laughter)—to London at the rate of 500 words per minute. It seems to me an ample demonstration of the utter scientific absurdity of any sentimental need for a separate Parliament in Ireland." (Laughter and applause.) As a member of the Upper House he voted against Mr. Gladstone's Home Rule Bill on some principle of Conservative dynamics or of statics.

Lord Kelvin has enjoyed all the prizes

of a scientific career. Social distinctions which "able" men court, if they do not seek, have been showered upon him as he ran his course. His inventions have been rewarded with riches, his learning with academic honours, his public services with rank and station. His triumphs have been fairly won, and nobody who knows the man, or his Herculean labours, will begrudge his trophies. His merit is of that transcendant order which towers above rivalry, and never arouses envy, unless it be in the breast of some conceited ignoramus. I shall only enumerate a few of his titles and decorations. He is or was an M.D. of Heidelberg, LL.D. of Cambridge and other universities, a D.C.L. of Oxford, president of a great many learned societies, including the Royal Society of Edinburgh, the Institution of Electrical Engineers, and the British Association for the

Advancement of Science. From 1891-6 he was President of the Royal Society of London, which since the time of Newton has been the highest professional honour to which a British man of science can aspire. He is a Foreign Associate of the Academy of Sciences, Paris, and an honorary member of similar bodies in other countries. He is a Grand Officer of the Legion of Honour, the highest ribbon in France save one, which is reserved for princes and the most illustrious public personages; a Knight of the Ordre pour le Mérite of Germany, a Commander of the Order of Leopold of Belgium, a Commander of the Order of the Rose, Brazil, and a Knight Grand Cross of the Victorian Order for distinguished services.

At the beginning of 1892 he was raised to the peerage by Queen Victoria; and his elevation, so richly deserved

was hailed with lively satisfaction by his scientific brethren, who regarded it as a public compliment to the pursuit of science. The style and title he assumed was that of Baron Kelvin of Netherhall, Largs. It was happily chosen, although electricians were at first inclined to regret the loss of the familiar "Thomson." Netherhall, his country seat, on the coast of Ayrshire, is a fine mansion built by himself and replete with modern improvements. The Kelvin is a beautiful and romantic stream which rises in the Campsie Fells, and after flowing past the grounds of the new college—the far-famed "Kelvingrove" of the old song—falls into the Clyde near Partick. Clear and wimpling at its source, the river is hopelessly polluted with dye-stuffs and other abominations in passing through Glasgow, and it is to be hoped that Lord Kelvin, if only for his name's

sake, will make a strong endeavour to redeem its lost purity.

His coat of arms, while showing his descent from a Scottish family of the surname, is an emblem of his career. A thunderbolt between two stars and a stag's head on the shield are supported by a student of the University of Glasgow, in cap and gown, holding a marine voltmeter, and a sailor with a sounding line. The crest is a hand grasping five ears of rye, and the motto beneath it is, "Honesty without Fear."

CHAPTER VI.

AS A PROFESSOR.

THE new College on Gilmorehill, at the west end of Glasgow, was designed by Sir Gilbert Scott, R.A., and publicly opened in 1870. Lord Kelvin's former house—which, as may be imagined, was provided with every scientific luxury and convenience, such as the electric light, the telephone, pipe-heaters, and astronomical time—stands at the north-western corner. The natural philosophy department is situated near at hand in that portion of the college front immediately to the right of the western archway, the class and apparatus rooms being on the upper and the physical laboratory on the ground floor. The routine work of the class was undertaken by Dr. James Thomson

Bottomley, F.R.S., a distinguished nephew of Lord Kelvin, and the other assistants. Only on certain days a week and on certain subjects did Lord Kelvin lecture, and it was chiefly the advanced students who profited by his instruction. A large number of the elementary class are Divinity and Arts students having little or no interest in science, or special capacity for it, beyond learning the modicum prescribed for taking their degree. Some, in fact, are wild Donalds from the hillsides and raw Sandies from the plough-tail. What they require is, to be led on by easy steps to a clear and simple understanding of the subject, with the requisite calculations and experiments.

The Pegasus of Lord Kelvin is not well broken to a crawling pace, and is fain to spurn the trammels of a baby or a donkey cart and soar into his

native ether, where few can follow him. I have heard that, many years ago, during a course of lectures on magnetism, his characteristic definition of an ideal magnet as "an infinitely long, infinitely thin, uniform and uniformly and longitudinally magnetised bar," was received by the back benches with a loud demonstration of the feet which drew forth a sharp "Silence!" from the Professor. Before the end of the session the definition had been repeated so often, to the accompanying tramp of their feet, and the reprimand had become so much a part of it, that one day, when, through accident or design, the students failed to respond, Lord Kelvin cried out "Silence!" all the same. The inspiration of the master mind was lost on such hearers, and the daring flights of his erratic imagination, the diversity and fulness

of his knowledge, his passionate denunciations of all that is irrational and blind, were apt to be regarded by them as a profitless entertainment. When, by the intensity of his feelings, or the eccentricity of his genius, he shot away from the point, and roundly condemned the "unhappy British inch," when he doted upon his ideal vats and fluids, or bandied incredible millions of suns and moons about with all the legerdemain of a Cinquevalli, when he rushed into the midst of his artificial molecules, or danced away with the "Sorting Demon" of Maxwell, the incorrigible back benches, maliciously diverted, were prone to become uproarious.

Sometimes one of his marvellous dissertations, the spontaneous utterance of his mind, would burst forth like the brilliant stars of a rocket at the very close of the hour, when the bell was

ringing for another class, and the sea of touzled heads before him, some of them as empty of the matter as a New Zealander's, had grown so stormy with impatience that he would have to lift his voice and cry above the din. These original digressions and impromptu perorations, containing the priceless jewels of his discourse, were simply flung away on all except the abler and wiser scholars, who listened with rapt attention to the flashing torrent, the impetuous cataract of his genius. They enjoyed the rapid medley of bright ideas, invaluable precepts, and sublime speculations, often expressed in eloquent phrases that stuck in the memory as the true romance, the grander poetry of Science; and it is still a matter of regret to some that no record has been kept of them for the edification of posterity. I can only remember one as I write. He was

speaking, if I am right, on the far-reaching influence of stresses or vibrations, and suddenly exclaimed, "I lay this piece of chalk upon a granite mountain and it *strains the whole earth!*" Lord Kelvin's merit as an educator lies not so much in the elucidation of well-known facts as in the spiritual influence of his magnetic personality. A minor physicist, more on a level with the average freshman, may, by talent and cultivation, prove an admirable teacher of science, but he is unable to inspire the student with hero-worship by presenting to him the living standard of a truly great mind. To the superior pupils of his class Lord Kelvin was a revelation of what a genuine man can do. There is something god-like in his profound intellect and tireless energy. The sincerity with which he labours, as though science were the all-in-all, is of

itself a never-to-be-forgotten lesson. They catch his enthusiasm, emulate his activity, and some even ape his manner. There are eminent men in every part of the world who owe their success in life to the contact electricity of Lord Kelvin.

At the conclusion of his lecture he was wont to pay a visit to the laboratory and superintend the experiments of the students. After that, he would run down to White's workshop in the town and give directions about his inventions, or, unless otherwise engaged, retire to his study beside the class-room, and dictate scientific papers to his secretary. It was not unusual for him to continue this work until the small hours of the morning. Alone in the deserted college, save for the companion of his vigils, he would sit by the fireside, with a cigar in his mouth, reading the ponderous tomes of some

old philosopher laid upon his knee, or thinking out some difficult problem, while now and again he drew a long ecstatic breath, and a look of deep satisfaction would overspread his countenance. His physical is almost on a par with his mental enterprise. Notwithstanding his profound knowledge of the laws of inertia, rather than lose a train he has been guilty of jumping into it while moving, in defiance of the angry porters, who threatened to put him in the "Stone Jug." It has been wittily suggested that his lameness was really a blessing in disguise, else but for that he might have attempted to fly in the air and broken his neck. Sometimes he was accorded the privileges of his fame with a better grace, as when in crossing to Belfast in his yacht, and being anxious to get sooner into the town, he hailed a chance excursion steamer filled with

Irish lads and lasses, and was taken on board with all his party. On his offering to pay for the band, the captain of the steamer replied with conscious pride, "Nothing from *you*, sir."

In summer he often cruised in his own sailing yacht, the *Lalla Rookh*, wherever the calls of business or the fancy took him—from the Hebrides to the Mediterranean or Madeira, but, in general, down the Clyde. A lover of the sea, finding pleasure in its gales and freedom on its breast, he sought it for study as well as recreation. It was on board the schooner that he perfected some of his inventions, especially the sounding machine. Notebook in hand, he would observe the waves and ripples, which, by the by, make beautiful patterns on the calm inlets of the West Highlands, for example on Loch Ridden, when a

steamer passes. Night after night he would sit up till the early hours of the dawn, sunk in the queer problems and forgotten lore of some old volume on wave motion. A bold sailor, at least when a single man, he would frighten the very captain of his yacht by running her into these perilous waters on the dark nights late in the season towards the beginning of November. On one occasion Professor Von Helmholtz was amongst the guests on board, and the *savants* by way of pastime began to give each other scientific conundrums of the most puzzling sort. It was observed by my informant, Professor G. A. Hill, an American, that while Helmholtz and Kelvin solved about the same number of the problems, the Irishman was quicker with his answers than the German. With great powers, otherwise equal, quickness gives the advantage,

especially in practical affairs. In truth, Lord Kelvin thinks with an electrical rapidity. He does not appear to weigh and reason like most men, but to reach his results by pure intuition.

This peculiarity is in agreement with a definition of genius by Mr. Francis Galton, which on the whole is singularly applicable to Lord Kelvin. "It appears to me," he remarks in his "English Men of Science," "that what is meant by genius, when the word is used in a special sense, is the automatic activity of the mind, as distinguished from the effort of the will. In a man of genius the ideas come as by inspiration; in other words, his character is enthusiastic, his mental associations are rapid, numerous, and firm, his imagination is vivid, and he is driven rather than drives himself. All men have some genius: they are all apt under excitement to show flashes

of unusual enthusiasm, and to experience swift and strange associations of ideas: in dreams, all men commonly exhibit more vivid powers of imagination than are possessed by the greatest artists when awake. Sober plodding will is quite another quality, and its over-exercise exhausts the more sprightly functions of the mind, as is expressed by the proverb, 'Too much work makes a dull boy.' But no man is likely to achieve very high success in whom the automatic power of the mind, or genius in its special sense, and a sober will, are not well developed and fairly balanced."

No phenomenon, however commonplace or trivial, is beneath the notice of Lord Kelvin, particularly when it illustrates the problems in his mind. I have seen him stop and watch the whirls of dust on the hearth-stones of the physical laboratory at Gilmorehill,

in hopes, no doubt, of getting a hint on his vortex theory of atoms. Another day, I remember, as he was hastening from a cable factory at Millwall, through the docks to catch a train, his eye fell on a little flow of mud by the way, and he suddenly paused to examine it in silence. Probably it appealed to him as an experiment in the motion of glaciers and other viscous bodies.

Ever awake to the scientific aspects of nature, as he travels about, many useful and even decisive observations have come from his pen. Thus, on 7th August, 1899, he wrote from Aix-les-Bains:—

"Last night during a thunderstorm of rare severity, in which brilliant flashes —single, double, triple or quadruple— followed one another at intervals of not more than a few seconds of time, I was surprised to see with great vividness, on

a suddenly illuminated sky, two nearly vertical lines of darkness, each of the ordinary jagged appearance of a bright flash of lightning. I remembered to have seen two real flashes of just the same shapes and relative positions, and I concluded that the black flashes were due to their residual influence on the retina. I turned my eyes quickly from the dark sky outside to an illuminated wall inside the house, and I again saw the same double dark 'flash,' which verified my conclusions in an interesting manner. The fatigued part of the eye failed to perceive the sudden brightness of the sky in the one case and of the wall in the other." The fact helps to explain the dark lightning flashes which are seen on photographs, where the sensitive plate of the camera is analogous to the retina of the eye.

Lord Kelvin is gifted with a very

keen perception. Few things escape his notice, although he may not seem to observe them. His memory is uncommonly retentive, his reasoning faculty most clear and precise, and his imagination strong and fecund. These rare endowments are all stimulated by a perfervid zeal—a vehement enthusiasm for the pursuit of science. The hackneyed epithets, a "strong bias," an "inborn taste," are all too feeble to portray the irrepressible instinct, the overmastering passion which is eternally goading him to the study of dead matter. See him engrossed in the subject of his discourse, and utterly forgetful of himself, or wild with rapture over the result of an experiment, and you will say this man was created for science, that he is a prophet or seer with a divine mission to reveal the physical laws. Finding his deepest joy in congenial labour, and so little

inclined to frivolity that ordinary pleasures were in danger of proving irksome or a waste of time, Lord Kelvin has not required to cultivate a habit of perseverance and concentration. The risk has rather been that he might not take sufficient rest or diversion, and the perpetual activity of his mind in the same groove break down the bodily machine. Fortunately his splendid fund of health and energy has proved itself capable of meeting the extravagant demands of his genius. Excepting an accident on the ice, which injured his right leg, he seems to have escaped the common ailments of humanity. During his busiest period, while a widower, he would work all day at a white heat, so to speak, yet he seldom or never appeared to tire, and a few hours of sleep were in general sufficient to recuperate his powers.

In addition to his academical duties,

his cable work, and his inventions or experiments, he was then engaged on several books, including his "Natural Philosophy," and spent so much time at the college that his meals became very irregular, and a grey parrot, "Dr. Redtail," which he had brought from Brazil, used to greet him with the remark, "Late again, Sir William." At length the evil became so desperate that he gave orders for his luncheon to be on the table at a fixed hour, whether he was there or not! He is too alert to be called "absent-minded" in the ordinary sense; but the story goes that he once fell asleep in his chair while presiding at a public dinner in Glasgow No doubt he was cruelly overworkea, but perhaps the banquet was not so lively as it might have been. In the midst of his most practical and profitable employments, the old charm for some theoretical

subject will revive and take entire possession of him for several days, holding him spell-bound. This waywardness of genius is perhaps a relief to the mind, and by changing the current of its thoughts may act as a recreation. Alternations of physical with mental exertion have also tended to promote his health in lieu of outdoor games and field sports. The study of the winter session was corrected by the travel of the long summer vocation.

CHAPTER VII.

AS A MAN.

Lord Kelvin is so devoted to science that he may appear to neglect other matters, until by some casual remark we are surprised at the extent of his acquaintance with them. He is so accustomed to impart learning, rather than receive it, that we are apt to think it is born in him. He is preternaturally quick to learn, and seems to imbibe knowledge with the air he breathes, or by the pores of his skin. His sympathies with the older studies have not been undermined by the new, and he maintains the importance of the classics, as well as of logic and moral philosophy. If he is intolerant of any branch it is metaphysics (I do not mention spiritualism here), and in his lectures

he occasionally came down heavily on it. The active nature of the man is antagonistic to all wool-gathering and idle dreams. He takes to life as a duck takes to the water, and never preaches or philosophises about it. If he questions his existence at all, and moralises on his aims or conduct, it is only at odd moments, and the result is kept a secret.

Great mathematician as he is, Lord Kelvin, like the illustrious Ampère, is easily confused by simple sums in arithmetic; and in recollecting his repeated mistakes in addition or subtraction on the blackboard, and the vindictive pleasure of the class in calling his attention to them, I am reminded of a sentence in Lord Lytton's "What Will He Do With It": "Notable type of that grandest order of all human genius, which seems to arrive at results by intuition—which a child might

pose by a row of figures on a slate—while it is solving the laws that link the stars to infinity."

Where the intellect is so predominant and impressive the real character is not very easily seen. Lord Kelvin is unquestionably a man of high honour, independent judgment, honesty, truthfulness, and sincerity. A philosopher, he is resolute and decided; a genius, he is orderly and methodical, careful of details, liking to dot his i's and stroke his t's. The purist in science may lament the time he has given to inventions or engineering, and hint that his rare philosophic genius, like the pure waters of the Kelvin, has been soiled by commerce; but his integrity is never impugned. Theory is the soul of practice, and if the soul is higher than the body, the one without the other is of little use in this world. Day by day

the importance of applied science is becoming more manifest, and Lord Kelvin is typical of his age in covering the whole field. I suspect that his characteristic energies required an outlet in practical life. That, like other inventors, and even poets such as Lord Tennyson, he sold his inventions for the highest terms he could get, is hardly a reproach in our time.

His manner is unaffectedly natural. He assumes no airs of genius or superiority, and is singularly free from haughtiness, conceit, or even self-consciousness. He exhibits none of the vanity and cocksureness with which the average young professor bristles like a hedgehog. When facts are against his opinion or hypothesis, no false pride restrains him from sacrificing it, and owning his mistake, whether in public or in private. A trifling dispute on the vanishing point of a picture

arose between him and Professor Fleeming Jenkin one day, and four months afterwards he owned that he was in the wrong. He is far above the common weakness of magnifying his work, or of taking credit for the achievements of others. Scrupulously careful to give honour where honour is due, the danger is rather that in his delight and enthusiasm over a novelty he may unduly praise it. The original observations of his assistants and students, although made in the course of experiments promoted by himself, are never appropriated by him, but always generously accredited to them, and apparently with more pride and pleasure than if they had been his own. I shall never forget his boyish enchantment in listening to a simple and popular lecture on Centrifugal Force. He could hardly contain himself, but ever and anon energetically clapped his hands, and

cried out, "That's very fine!" His reverence for the great scientific names of old, as well as of to-day, and his own genuine modesty are beautiful and charming things to see. Looking further into the mysteries of nature than other men, and realising how little we know, he is animated by the humble spirit of Newton, who compared himself to a child gathering pebbles on the shore of the immense ocean of truth. When, on Graduation Day of 1891, the students of Glasgow offered him their congratulations on his election to the Presidency of the Royal Society of London, and thanked him for his uniform courtesy and kindness, he placed himself on their own level. "While you have shown your sympathy with me," he said, "I wish to express my sympathy with you. I have been a student of the University of Glasgow fifty-five years to-day, and I hope to

continue a student of the University as long as I live." He takes a warm interest in his old pupils, greeting them heartily, and showing pride in their achievements. They, on the other hand, never forget him, and if in the battle of life his lucubrations on dynamics have gone the way of all knowledge, his lovable traits continue to refresh their hearts, and his example to inspirit them.

With an intellect deep and subtle as the sea, and a vast, though professional, experience of the world, there is, nevertheless, a certain childlike innocence and simplicity in Lord Kelvin which, if not a mark of true genius, is often found along with it. A small and vulgar nature, cunning in worldly wiles, might perhaps impose upon him—for a time, at least.

A reminiscence of the old college betrays this guileless trust or naive

ignorance of ordinary human nature. In those days the roll of his class was called by "censors," that is to say, students appointed for the purpose. The antiquated custom pestered him, and, after an expense of brain exceeding that of his more immortal discoveries, he devised a mechanical substitute. It was, I believe, an oblong mahogany box with a glass front which held a bobbin of paper turned by a screw outside. An opening at one end allowed the pupils to inscribe their names under the date as they entered the class-room. Of course the absentees got their obliging friends to sign for them, but the ingenuous professor did not suspect the fraud until one day, while examining the students by word of mouth, he called on truant after truant without any response, and in surprise went to consult the register

amidst the suppressed and general tittering of the class.

Genius, with its superior insight and highly-strung temperament, is liable to a certain intolerance of mediocrity and its ways, and Lord Kelvin appears as sensitive to a blunder in mechanics as a musician to a jarring note; but if his eager spirit grows impatient of stupidity or clumsiness on the part of a student or workman, it is only for a moment, and seldom or never offensive. His little frets of annoyance are quickly appeased, and often end in a sweet and captivating smile. He evinces an extreme sympathy with pain, and I well remember his unfeigned concern when a student ran a gouge into his hand one day in the laboratory. A sensibility so acute may lead to embarrassing circumstances, and it sometimes happened that in hurrying to catch a train against time he would keep thrusting

his head out of the cab and urge the cabman to "drive faster!" only to shrink back in evident distress at the resulting crack of the whip. His kindness to dumb animals is well known, and he has more than once taken a public part in preventing their ill-usage. His first wife had a little black-and-tan terrier called "Fido" or "Fanny," which he treated with infinite tenderness. "Fido" did her best to advance electric science by furnishing the black hairs which he employed in the gauges of his electrometers. I have been told by Mr. John Tatlock, formerly his lecture assistant and secretary, that one day when a guest on board his yacht levelled a fowling-piece at a sea-bird, he became white with indignation, and arrested the shot by seizing the sportsman's arm.

The highest genius, from its nature, is, and must be, in a measure lonely; hence Lord Kelvin is at times pre-

occupied with his studies, but for all that he is of a sociable turn, and fond of company. He enjoys a good dinner, and is not above the humours of a comic song. Indeed, he has perpetrated more than one joke himself. "When is blotting-paper — blotting-paper?" he asked a fellow-professor. "I give it up," was the reply. "*Never!*" he cried in great glee.

The celebration of his jubilee as professor by the University and City of Glasgow, in June, 1896, was the crowning honour of his life. Delegates of the universities and learned societies, distinguished men of science, friends or colleagues of his own, many old students, gathered from all quarters of the civilised world, in testimony of their admiration and respect for the great master. Of these, about a hundred and fifty came from the United Kingdom, and fifty more from

the Colonies, India, the United States, and various foreign countries. The whole scientific world united to do him honour, and Professor Mascart, a famous French electrician, summed up the universal opinion when, at the presentation of addresses to Lord Kelvin, he said:—"Whatever the future reserves to the inventive genius of the human mind, your name will remain as having been the guide in a fecund epoch, and the true educator of the actual generation in the domain of electricity. I am particularly happy that the Academy of Sciences has confided to me the care of committing to you a gold medal bearing the effigy of Arago, which is reserved for homage to exceptional services rendered to science, and carries the device, 'Laudes damus posteri gloriam.'" It had only been awarded thrice before.

At the banquet, given afterwards, General Ferrero, the Italian Ambassador, speaking in French, expressed the common mind of the delegates by saying that "We have taken part in the apotheosis of science," and thanking Providence for having "confided to us an inestimable treasure in the person of Lord Kelvin."

Nor was Lady Kelvin forgotten on this memorable occasion. She is an admirable, perhaps it might be said an ideal, helpmate for such a man. Having much in common, they are also a contrast, each possessing some corrective and complementary qualities of mind and character which appear to promote happiness in union. Her intelligence and sympathy in his pursuits make her a true companion for him, partaking his joys, encouraging his labours, and consoling his griefs. The repose of her manner probably

soothes and stimulates by turns his own restless temperament. Her tact, forethought, and patience, her practical skill reinforcing his own, her care in watching over his health, guarding his privacy, reminding him of engagements, and sparing him the small yet often important observances of ordinary life, so distracting, if not annoying to genius, are of incalculable service, and have left him free to perform his public duties or to follow his vocation.

"One word," he modestly cried, in answer to their praises and congratulations, "one word characterises the most strenuous of the efforts for the advancement of science that I have made perseveringly during fifty-five years—that word is FAILURE! I know no more of electric and magnetic force, or of the relation between ether, electricity, and ponderable matter, or of chemical

affinity, than I knew and tried to teach my students of natural philosophy fifty years ago, in my first session as professor. Something of sadness must come of failure; but in the pursuit of science, inborn necessity to make the effort brings with it much of the *certaminis gaudia*, and saves the naturalist from being wholly miserable, perhaps even allows him to be fairly happy in his daily work."

Doubtless the great enigma, "What is electricity?" remains, but Lord Kelvin, at all events, has cleared the way to a solution. The rays of his genius, penetrating the cavern of mysteries, have illuminated the dark foundation of the universe, and if they cannot search it to the bottom, his followers, with torches kindled at his flame, may by and by achieve the task.

Lord Kelvin is a candid and earnest, but not always an eloquent or happy,

speaker. Whether he is overcome by emotion, or the subject is frequently strange to his thoughts, few or none by hearing his utterances after dinners and at other social functions would suspect his incomparable genius. He does not appear to the best advantage on such popular occasions. Perhaps he is nervous, perhaps he is a little out of his element, and off the line of his exceptional endowments, for his inspiration seems to abandon him and he becomes like an ordinary mortal—I had almost written a child. Only now and then does the superior mind flash out. He rambles away from his theme, and sometimes, through ignorance, commits a *gaucherie*, as when he praised photography to the artists of the Royal Academy. Wit and humour, as a rule, do not sit easily upon him. Very often his attempts to be funny are not so amusing as his most serious

remarks. If his jokes and railleries miss fire, his oddities and eccentricities never fail to provoke mirth. Glaswegians would smile at his recollections of the old college in the slums of the High Street and Vennel, "not very far from the comforts of the Saltmarket," and of the natural philosophy class and apparatus rooms which were "almost an earthly paradise" to his youthful mind, but his confession about the College Green, and the spell cast over it in "Rob Roy" by the Wizard of the North, as a revelation of his romance hidden under the science, like a vein of crystals in the rock, would surprise many who are kept aloof by his learning into a new and kindlier fellow-feeling with him.

The homage shown to Lord Kelvin at his jubilee was the greatest ever paid to a man of science. It was not only a sign of universal esteem, or the grateful

appreciation of work done. It was a pledge for the future that makers of empire over matter, no less than conquerors of states, would receive their public triumphs.

Lord Kelvin was induced by the Senate to continue in his professorship until 1899, and, at his own desire, he still remains on the roll of the University as a research student, with a right to experiment in the physical laboratory. He stood for the Lord Rectorship against Lord Rosebery; but politicians are more popular than philosophers, even in colleges, and the students elected the dulcet orator of Dalmeny.

Nobody has a better claim to the rest and leisure of his age than Lord Kelvin; but he cannot be idle, and since his retirement has pursued his favourite studies. At the last meeting of the British Association in Glasgow, for instance, he read a paper on "Matter

in Interstellar Space." He is often invited to open technical or other institutions, and presides at public meetings or committees.

Baron Kelvin is one of those extraordinary men who are bound for greatness as the sparks fly upwards. Doubtless the time and place of his birth were favourable to him, but under any circumstances he would have risen to pre-eminence. He appears to have every requisite for the highest success —power of will, superabundance of intellect and energy, as well as a good measure of all the virtues, and religious faith. In him we are able to see what a really great man is like. His supreme ability is never disputed by anyone who knows him or his work. Indeed, all who come in contact with him, from the prince to the workman, are apt to fall under its commanding influence. Even a duke would find it natural to

serve him; and it is common enough to see him in the middle of a group of distinguished men as a planet is surrounded by its satellites, or rushing ahead of them like a fiery comet followed by its tail.

Such prodigies of nature are only produced at rare intervals, and it may be a long time before the world has another scientist of his calibre. It will be easier to estimate his true place and proportions hereafter from the standpoint of distance. Apparently, however, his name will go down to posterity with those of Galileo, Newton, and Pascal. So far he is unique in science by reason of his multifarious and diversified career. His achievements would suffice to make at least three eminent reputations, for not only is he the greatest physicist of the day, but the leading electrical engineer, and one of the most celebrated inventors. Our wonder at

the manifold lines of his activity is increased when we reflect that all of them are interwoven in a single piece. I would name him the Grand Old Man of Science were it not that from a political feeling he might scorn the comparison. Let us call him the Napoleon of Science, or—if the older fashion be more to his taste—the Napoleon of Natural Philosophy.

Printed by Henry J. Drane, Ye Saint Bride's Presse, Salisbury House, Salisbury Square, London, E.C.